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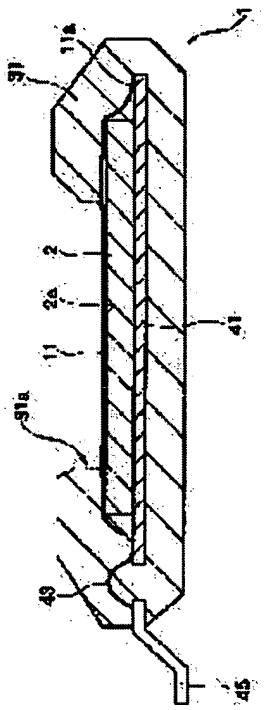
(54) CAPACITANCE TYPE FINGERPRINT SENSOR

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a capacitance type fingerprint sensor capable of preventing electrostatic breakdown due to discharge, for example, of capacitance detection cells constituting the capacitance type fingerprint sensor from a finger, and a manufacturing method therefor.

SOLUTION: This capacitance type fingerprint sensor 1 has a plurality of capacitance detection cells detecting electrically the capacitance changed in accordance with the distances to the fingerprint, and recognizes the fingerprint based on the results of detection of each capacitance detection cell. In this case, a wire 11 as a conductive wire material giving reference potential for the fingerprint is stretched and provided by crossing a detection face 2a on which the capacitance detection cells are provided.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The electrostatic-capacity type fingerprint sensor which is the electrostatic-capacity type fingerprint sensor which has two or more cels for electrostatic-capacity detection which detect electrically the electrostatic capacity which changes according to the distance between fingerprints, and recognizes said fingerprint based on the detection result of each of said cel for electrostatic detection and by which the conductive wire rod which gives a reference potential to said fingerprint is ****(ed) by crossing the detection side in which two or more of said cels for electrostatic-capacity detection were prepared.
[Claim 2] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 1 in contact with said detection side.
[Claim 3] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 1 currently isolated from said detection side.
[Claim 4] It is the electrostatic-capacity type fingerprint sensor according to claim 1 by which it has the semiconductor chip with which said two or more cels for electrostatic-capacity detection were formed, the attachment component which has the conductivity holding said semiconductor chip, and the package member which covers said semiconductor chip and attachment component where the detection side of said semiconductor chip is exposed, and is fixed, and the both ends of said wire rod are being fixed by said package member to said semiconductor chip.
[Claim 5] Said package member is an electrostatic-capacity type fingerprint sensor according to claim 3 which consists of a resin ingredient.
[Claim 6] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 4 electrically connected with said attachment component through the inside of said package member.
[Claim 7] It is the electrostatic-capacity type fingerprint sensor according to claim 6 by which it has the electrode for reference potentials which was prepared so that a part might project from the package member concerned in said package member, and which is connected to a reference potential, and said electrode for reference potentials is connected with said attachment component by the conductive ingredient.
[Claim 8] It is the electrostatic-capacity type fingerprint sensor according to claim 4 by which the spacing member for holding in the location which isolates said wire rod in a predetermined distance from the detection side concerned is prepared in the detection side side of said semiconductor chip, and said wire rod is being fixed by said package member on said spacing member.
[Claim 9] Said spacing member is an electrostatic-capacity type fingerprint sensor according to claim 7 which consists of the same ingredient as said package member.
[Claim 10] Said wire rod is an electrostatic-capacity type fingerprint sensor according to claim 1 which consists of a carbon fiber.
[Claim 11] Said cel for electrostatic-capacity detection is an electrostatic-capacity type fingerprint sensor according to claim 1 which has an electrode for detection, and the insulating protective coat of the predetermined thickness which covers said electrode for detection.

[Claim 12] It is the electrostatic-capacity type fingerprint sensor according to claim 1 by which it has further the digital disposal circuit which processes the detecting signal of said cel for electrostatic-capacity detection, and specifies said fingerprint, and said wire rod crosses said digital disposal circuit, or said wire rod processes specifically the detecting signal of the cel for electrostatic-capacity detection which passes through near.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electrostatic-capacity type fingerprint sensor and its manufacture approach for specifying a fingerprint.
[0002]
[Description of the Prior Art] for example, the fingerprint authentication system used for close leaving management etc. -- him, such as a security system on a computer network, a personal digital assistant, and an IC card, -- it is beginning to be applied also as an authentication tool. In the above-mentioned fingerprint authentication system, the electrostatic-capacity type fingerprint sensor is developed as a fingerprint sensor for recognizing a fingerprint. An electrostatic-capacity type fingerprint sensor detects electrically the electrostatic capacity which gives a reference potential to a finger and is formed between this reference potential and the electrode in a fingerprint sensor. According to the irregularity of a fingerprint, the distance of a reference potential and an electrode changes and electrostatic capacity changes. The crest of a fingerprint is specified by taking out electrically change of the electrostatic capacity corresponding to the irregularity of this fingerprint.
[0003]
[Problem(s) to be Solved by the Invention] Here, drawing 10 is the top view showing an example of the structure of the above-mentioned electrostatic-capacity type fingerprint sensor, and drawing 11 is the sectional view showing an example of the structure of the above-mentioned electrostatic-capacity type fingerprint sensor. As shown in drawing 10 , the electrostatic-capacity type fingerprint sensor 101 has two or more electrodes 102 for electrostatic-capacity detection arranged in the shape of a matrix, and the electrostatic-capacity detector cell is constituted by each electrode 102 for electrostatic-capacity detection. Moreover, on the electrode 102 for electrostatic-capacity detection, as shown in drawing 11 , the insulating protective coat 103 is covered. By the electrostatic-capacity type fingerprint sensor 101 of the above-mentioned structure, in order to make a finger into a reference potential recognizing a fingerprint, for example, as shown in drawing 12 , the reference potential electrode 105 was arranged near the detection side 101a of the electrostatic-capacity type fingerprint sensor 101, and the reference potential is given to Finger F. However, before the body tended to be electrified and the reference potential electrode 105 gave the reference potential to Finger F, discharge may occur between Finger F and the electrostatic-capacity type fingerprint sensor 101, and dielectric breakdown of the protective coat 103 grade of the electrostatic-capacity detector cell of the electrostatic-capacity type fingerprint sensor 101 might be carried out by this.
[0004] This invention is made in view of the problem mentioned above, and aims at offering the electrostatic-capacity type fingerprint sensor which can control the electrostatic discharge by the discharge from a finger etc. of the cel for electrostatic-capacity detection which constitutes an electrostatic-capacity type fingerprint sensor.
[0005]
[Means for Solving the Problem] This invention has two or more cels for electrostatic-capacity detection

which detect electrically the electrostatic capacity which changes according to the distance between fingerprints, and it is an electrostatic-capacity type fingerprint sensor which recognizes said fingerprint based on the detection result of each of said cel for electrostatic detection, and the conductive wire rod which gives a reference potential to said fingerprint crosses the detection side in which said two or more cels for electrostatic-capacity detection were prepared, and it is ****(ed).
[0006] Said wire rod touches said detection side.
[0007] Said wire rod is being isolated from said detection side.
[0008] It has the semiconductor chip with which said two or more cels for electrostatic-capacity detection were formed, the attachment component which has the conductivity holding said semiconductor chip, and the package member which covers said semiconductor chip and attachment component where the detection side of said semiconductor chip is exposed, and is fixed, and the both ends of said wire rod are being fixed by said package member to said semiconductor chip.
[0009] Said package member consists of a resin ingredient.
[0010] Said wire rod is electrically connected with said attachment component through the inside of said package member.
[0011] It has the electrode for reference potentials which was prepared so that a part might project from the package member concerned in said package member and which is connected to a reference potential, and said electrode for reference potentials is connected with said attachment component by the conductive ingredient.
[0012] The spacing member for holding in the location which isolates said wire rod in a predetermined distance from the detection side concerned is prepared in the detection side side of said chip, and said wire rod is being fixed by said package member on said spacing member.
[0013] Said spacing member consists of the same ingredient as said package member.
[0014] Said wire rod consists of a carbon fiber.
[0015] Said cel for electrostatic-capacity detection has an electrode for detection, and the insulating protective coat of the predetermined thickness which covers said electrode for detection.
[0016] It has further the digital disposal circuit which processes the detecting signal of said cel for electrostatic-capacity detection, and specifies said fingerprint, and said wire rod crosses said digital disposal circuit, or said wire rod processes specifically the detecting signal of the cel for electrostatic-capacity detection which passes through near.
[0017] In this invention, the wire rod which has the conductivity which gives a reference potential to a fingerprint so that it may cross to the control surface which detects a fingerprint is ****(ed). If a finger is pressed against a control surface, in order that a finger may contact a wire rod certainly, even if the discharge from a finger occurs, static electricity will escape through a wire rod. For this reason, it is controlled that the cel for electrostatic-capacity detection is destroyed by discharge.
[0018]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.
1st operation gestalt drawing 1 is the sectional view showing the structure of 1 operation gestalt of the electrostatic-capacity type fingerprint sensor of this invention, drawing 2 is the sectional view showing the structure of the cel for electrostatic-capacity detection, and drawing 3 is the top view showing the structure by the side of the detection side of a semiconductor chip. As shown in drawing 1 - drawing 3 , the electrostatic-capacity type fingerprint sensor 1 concerning this operation gestalt has a semiconductor chip 2, a die pad 41, the package member 31, a wire 11, and an earth electrode 45.
[0019] Two or more cels 3 for electrostatic-capacity detection for a semiconductor chip 2 to detect a fingerprint, as shown in drawing 3 are formed in the shape of a matrix. A semiconductor chip 2 is 2 several cm, for example. It has the area of extent, and the cel 2 for electrostatic-capacity detection is formed by the order of tens of thousands - 100,000 numbers in this area, for example, it is arranged at intervals of several micrometers - dozens of micrometers. As shown in drawing 3 , the cel 3 for electrostatic-capacity detection has the electrode 21 which consists of a conductive ingredient formed on the insulating layer 20, and these electrodes 21 are covered with the protective coat 22 which consists of

a dielectric. In addition, the maximum front face of a protective coat 22 is the above-mentioned detection side 2a. The electrode 21 of the cel 3 for electrostatic-capacity detection is formed from metallic materials, such as aluminum, and die length of one side is formed in dozens of micrometers. A protective coat 22 is SiN and SiO2. It is the film with a thickness of several micrometers used as a base material.

[0020] the formation approach of the cel 3 for electrostatic-capacity detection -- for example, a semi-conductor substrates top, such as a silicon substrate, -- at least -- an insulating layer -- minding -- for example, CVD (Chemical Vapour Deposition) -- the conductive layer which consists of a metallic material using law etc. is formed, patterning is carried out using the usual photolithography technique, an electrode 21 is formed, and a protective coat 22 is made to deposit in predetermined thickness so that an electrode 21 may be covered

[0021] The die pad 41 holds the semiconductor chip 2 through a binder. A die pad 41 is a plate which consists of a metallic material which has conductivity, such as copper and aluminum.

[0022] The package member 31 is formed so that a semiconductor chip 2 and a die pad 4 may be covered, and it is fixing the semiconductor chip 2 and the die pad 4. Moreover, the package member 31 is formed from the resin ingredient used for the package of the usual semiconductor device. Moreover, the package member 31 has opening 3a so that detection side 2a of a semiconductor chip 2 may be exposed.

[0023] Although a wire 11 is a wire rod which has conductivity, for example, wire rods, such as a stainless steel wire, can be used for it, with this operation gestalt, a carbon fiber is used for it from a viewpoint on reinforcement. As a wire 11 crosses detection side 2a, and is ****(ed), where detection side 2a of a semiconductor chip 2 is contacted, for example, shown in drawing 3 , it is prepared so that the cel 3 for electrostatic-capacity detection arranged in the same direction as shown by hatching may be crossed. Moreover, for example, as shown in drawing 4 , you may prepare so that between each cel 3 for electrostatic-capacity detection arranged in the same direction may be crossed. The both ends of a wire 11 are being fixed in one in the package member 31 to the semiconductor chip 2, as shown in drawing 1 .

[0024] It connected with the front face of a die pad 41, and the wire 11 and the die pad 41 have flowed through end section 11a of a wire 11 electrically.

[0025] It is fixed in the package member 31, and the earth electrode 45 is formed so that a part may project from the package member 31. The earth electrode 45 is electrically connected with the die pad 41 by the conductive members 43, such as a gold streak and an aluminum wire. The conductive member 43 exists in the package member 31.

[0026] Drawing 5 is the mimetic diagram showing the electric configuration of the electrostatic-capacity type fingerprint sensor 1 concerning this operation gestalt. As shown in drawing 5 , the electrode 21 of each cel 3 for electrostatic-capacity detection is connected to the digital disposal circuit 51 through the transistor 40 which functions as a switch. The gate of the transistor 40 connected to the cel 3 for electrostatic-capacity detection located in a line with the same line among the cels 3 for electrostatic-capacity detection arranged in the shape of a matrix is connected to the selection line WL. A digital disposal circuit 51 is a circuit which specifies the image of the fingerprint of Finger F based on the detecting signal which each cel 3 for electrostatic-capacity detection detected.

[0027] Here, the detection principle of the fingerprint of the electrostatic-capacity type fingerprint sensor 1 is explained. As shown in drawing 6 , the electrode 21 of each cel 4 for electrostatic-capacity detection is connected to the selection line BL of the direction of a train through a transistor 40, and the gate of a transistor 40 is connected to the selection line WL of a line writing direction. When the finger F which gave the reference potential is located in the location of distance d from an electrode 21, the electrostatic capacity Cs between an electrode 21 and Finger F is expressed by the degree type (1). In addition, epsilon 0 It is the dielectric constant of air, epsilon is the dielectric constant of the protective coat 22 on an electrode 21, and S is the area of an electrode 21.

[0028] Cs=epsilon-epsilon 0 and S/d -- (1)

[0029] Therefore, in the condition of not making Finger F countering the electrode 21 of the

electrostatic-capacity type fingerprint sensor 1, the distance d of an electrode 21 and Finger F becomes infinite, and the electrostatic capacity Cs on an electrode 21 is set to 0.
[0030] When the electrode 21 of the electrostatic-capacity type fingerprint sensor 1 is made to approach where a reference potential E is given to Finger F as shown in drawing 7 , the distance d of Electrodes 21a and 21b and Finger F changes like d1 and d2 with irregularity of the fingerprint which Finger F has, respectively. If the selection line BL is precharged on the predetermined electrical potential difference Vcc, an electrical potential difference is impressed to the selection line WL at this time and a transistor 40 is turned on, the charge according to the electrostatic capacity Cs determined with distance d1 and d2 will be accumulated in each electrodes 21a and 21b, and the potential of the selection line BL will change according to the amount of these charges. Potential variation deltaV of the selection line BL is expressed with a degree type (2) when parasitic capacitance of the selection line BL is set to Cb.
[0031]
deltaV= {Cs/(Cb+Cs)} Vcc -- (2)
[0032] Potential variation deltaV is an amount according to the electrostatic capacity Cs determined with the distance d of an electrode 21 and Finger F, and can specify the concave convex voice of the fingerprint which Finger F has by reading to the digital disposal circuit 51 which described above potential variation deltaV of the selection line BL in each cel 2 for electrostatic-capacity detection.
[0033] Next, an example of fingerprint detection actuation of the electrostatic-capacity type fingerprint sensor 1 of the above-mentioned configuration is explained. For example, the finger F contacted in the electrostatic-capacity type fingerprint sensor 1 is charged, and before giving a reference potential E to Finger F, the case where it discharges towards the electrostatic-capacity type fingerprint sensor 1 from Finger F is considered. In addition, the earth electrode 45 of the electrostatic-capacity type fingerprint sensor 1 shall be grounded. Since the wire 11 will cross on detection side 2a if Finger F is contacted to detection side 2a of a semiconductor chip 2 as shown in drawing 8 , Finger F is contact ****** certainly on a wire 11. The touch-down potential which is a reference potential is given to Finger F by this. If the body is charged and it discharges from Finger F when Finger F is brought close to detection side 2a of a semiconductor chip 2, the discharge current will flow on a wire 11 and will be led to the earth electrode 45 grounded through the die pad 41 and the conductive member 43. For this reason, it is controlled that the protective coat 22 grade which the discharge current does not flow directly in the cel 3 for electrostatic-capacity detection, and the cel 3 for electrostatic-capacity detection has by discharge carries out dielectric breakdown. As mentioned above, according to this operation gestalt, the cel 3 for electrostatic-capacity detection becomes that it is hard to be destroyed even if discharge arises from Finger F by having formed the wire 11 which has conductivity on detection side 2a in which two or more cels 3 for electrostatic-capacity detection were formed.
[0034] Here, in order that Finger F may contact a wire 11 where Finger F is contacted to detection side 2a of a semiconductor chip 2 as shown in drawing 8 , Finger F deforms in this surface of action. For this reason, the insensible field R which cannot detect a fingerprint occurs in the field which deformed Finger F. For example, when it prepares so that the cel 3 for electrostatic-capacity detection which arranges a wire 11 in the same direction may be crossed as shown in drawing 3 , each cel 3 for electrostatic-capacity detection on a par with the single tier shown by hatching in drawing 3 will be located in an insensible field R. Moreover, as shown in drawing 4 , when a wire 11 is formed between the cels 3 for electrostatic-capacity detection arranged in the same direction, each cel 3 for electrostatic-capacity detection of two adjacent trains shown by hatching in drawing 4 will be located in an insensible field R.
[0035] The cel 3 for electrostatic-capacity detection located in an insensible field R is beforehand specified according to arrangement of a wire 11 in the assembly phase of the electrostatic-capacity type fingerprint sensor 1. For this reason, with this operation gestalt, the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R by the digital disposal circuit 51 is processed specifically, for example. Specifically, a digital disposal circuit 51 can be considered as the configuration which does not use the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R for specification of a fingerprint. In this case, the overview of a

fingerprint can be specified by making a different location to detection side 2a of a semiconductor chip 2 carry out multiple-times contact of the finger F, and compounding the data obtained by detection of multiple times. Or the algorithm which processes specially the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R is prepared beforehand, and it is also possible to specify the overview of a fingerprint by complementing the detecting signal of the cel 3 for electrostatic-capacity detection located in an insensible field R with this algorithm.

[0036] 2nd operation gestalt drawing 9 is the sectional view showing the structure of 1 operation gestalt of the electrostatic-capacity type fingerprint sensor of this invention. In addition, the same sign shows the same component as the 1st operation gestalt mentioned above among the components of the electrostatic-capacity type fingerprint sensor 201 shown in drawing 9 . A different point of the electrostatic-capacity type fingerprint sensor 201 concerning this operation gestalt and the electrostatic-capacity type fingerprint sensor 1 concerning the 1st operation gestalt is a point which the wire 11 is isolating in detection side 2a of a semiconductor chip 2, and the predetermined distance delta by the electrostatic-capacity type fingerprint sensor 201.

[0037] That is, by the electrostatic-capacity type fingerprint sensor 201, two or more spacing members 46 of height delta are formed on the semiconductor chip 2, and a wire 11 is ****(ed) on a spacing member 46, and is being fixed to the package member 31 and one. A spacing member 46 can be formed with the same resin ingredient as the package member 31.

[0038] With this operation gestalt, if Finger F is brought close to detection side 2a of a semiconductor chip 2 by considering as such a configuration, since it is near, even if the wire 11 discharges from Finger F with Finger F rather than detection side 2a of a semiconductor chip 2, the discharge current is certainly led to a wire 11, and can prevent certainly the electrostatic discharge of the cel for electrostatic-capacity detection formed in the semiconductor chip 2.

[0039]

[Effect of the Invention] According to this invention, even if there is discharge from a finger by having prepared the wire which gives a reference potential, the electrostatic discharge of the cel for electrostatic-capacity detection can be certainly prevented, so that the detection side of an electrostatic-capacity type fingerprint sensor may be crossed, and a reference potential can be given to a finger.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the configuration of 1 operation gestalt of the electrostatic-capacity type fingerprint sensor concerning this invention.
[Drawing 2] It is the sectional view showing the structure of the cel for electrostatic-capacity detection.
[Drawing 3] It is the top view showing the structure by the side of the detection side of a semiconductor chip.
[Drawing 4] It is the top view showing other examples of structure by the side of the detection side of a semiconductor chip.
[Drawing 5] It is the mimetic diagram showing the electric configuration of the electrostatic-capacity type fingerprint sensor 1.
[Drawing 6] It is the top view showing an example of the structure of an electrostatic-capacity type fingerprint sensor.
[Drawing 7] It is drawing for explaining the detection principle of an electrostatic-capacity type fingerprint sensor.
[Drawing 8] It is drawing showing the condition of having made Finger F approaching detection side 2a of the semiconductor chip 2 of the electrostatic-capacity type fingerprint sensor 1. It is the sectional view showing an example of the structure of an electrostatic-capacity type fingerprint sensor.
[Drawing 9] It is the sectional view showing the configuration of other operation gestalten of the electrostatic-capacity type fingerprint sensor concerning this invention.
[Drawing 10] It is the top view showing an example of the structure of an electrostatic-capacity type fingerprint sensor.
[Drawing 11] It is the sectional view showing an example of the structure of the electrostatic-capacity type fingerprint sensor of drawing 10 .
[Drawing 12] In case a finger is contacted in an electrostatic-capacity type fingerprint sensor, it is drawing showing signs that a reference potential is given to a finger.
[Description of Notations]
1 [-- The cel for electrostatic-capacity detection, 11 / -- A wire, 31 / -- A package member, 43 / -- A conductive member, 45 / -- An earth electrode, 21 / -- An electrode, 22 / -- A protective coat, 41 / -- Die pad.] -- An electrostatic-capacity type fingerprint sensor, 2 -- A semiconductor chip, 2a -- A detection side, 3

[Translation done.]

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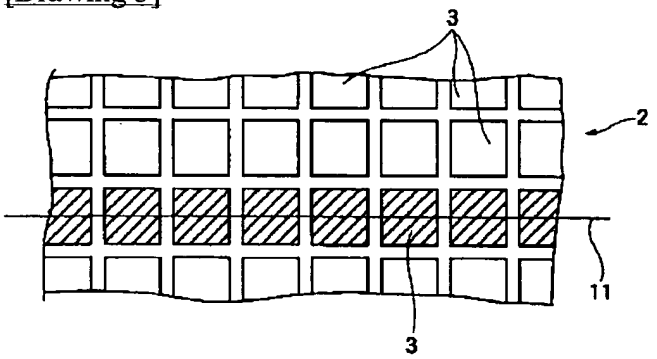
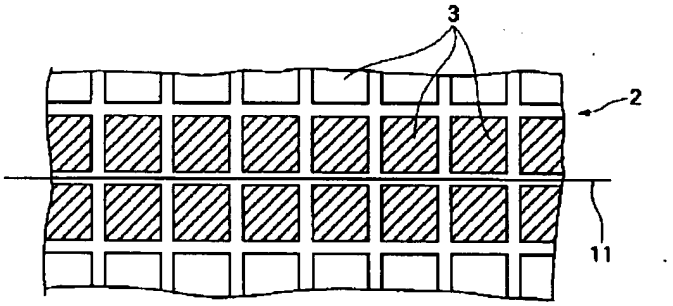
DRAWINGS

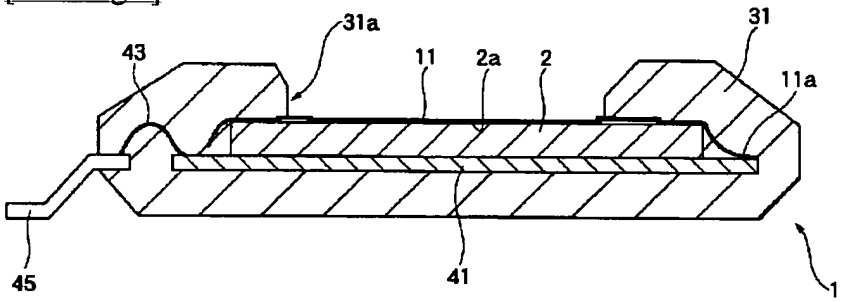
[Drawing 3]



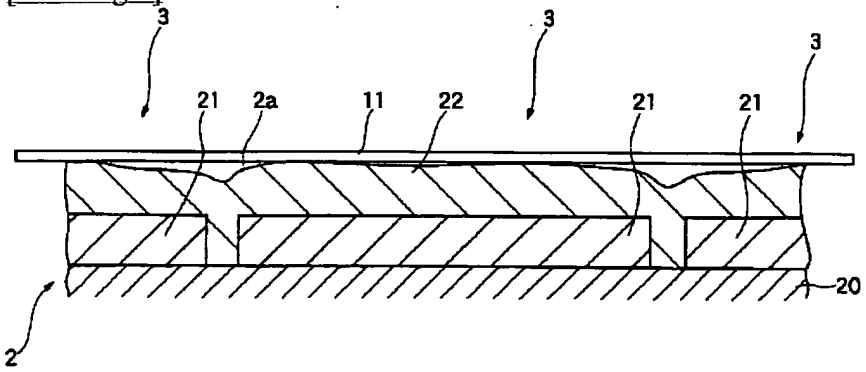
[Drawing 4]



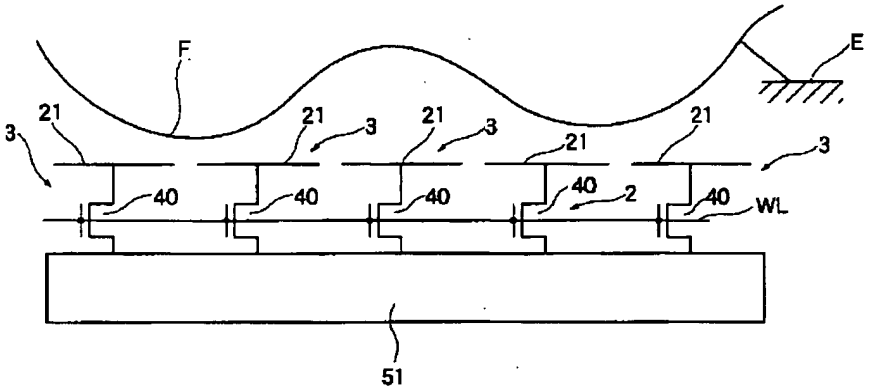
[Drawing 1]



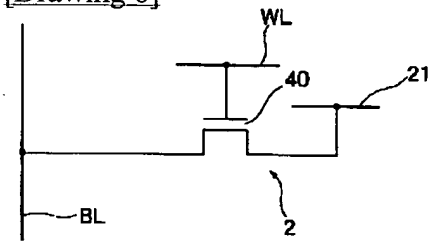
[Drawing 2]



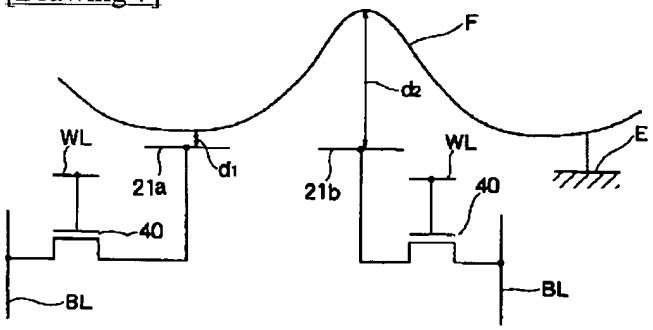
[Drawing 5]



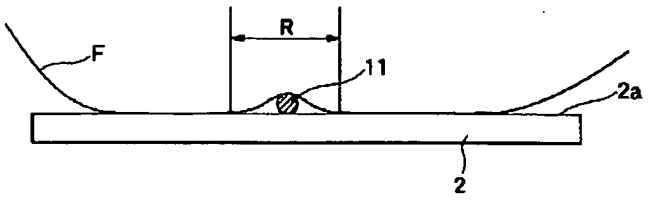
[Drawing 6]



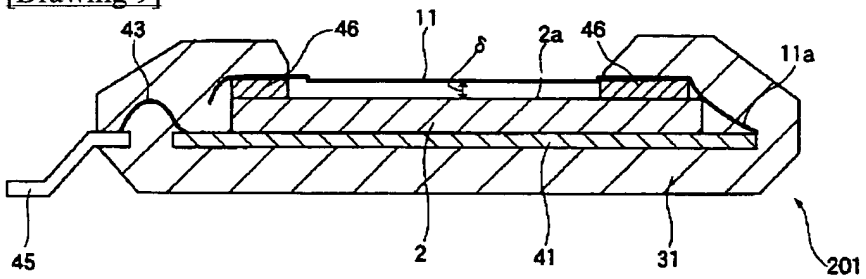
[Drawing 7]



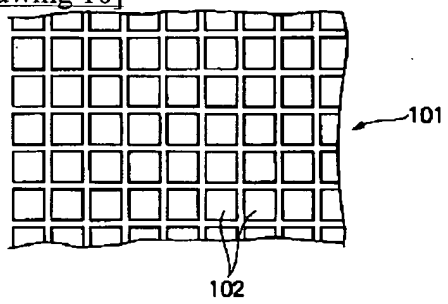
[Drawing 8]



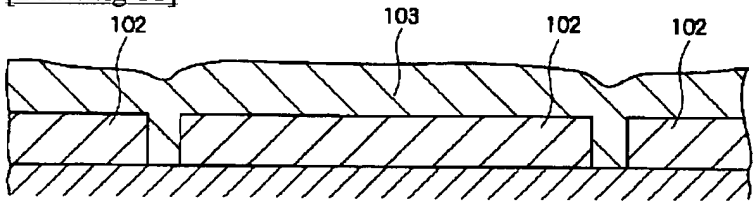
[Drawing 9]



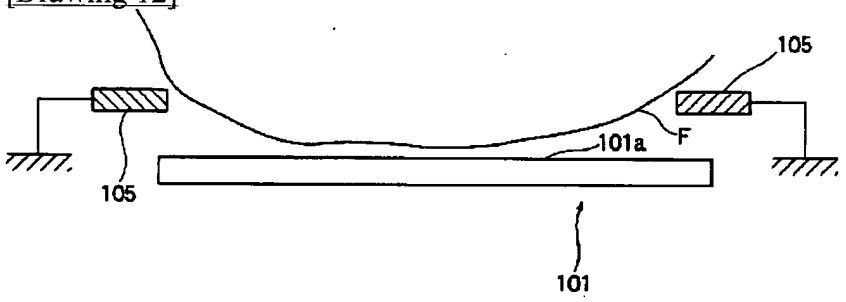
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]

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HA04 HA09 ZA10
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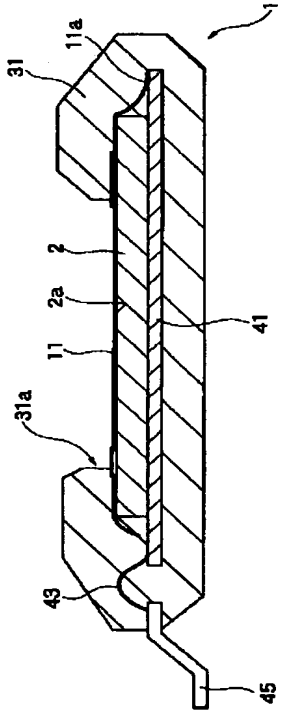
5B047 AA25

(54)【発明の名称】　静電容量式指紋センサ

(57)【要約】
【課題】静電容量式指紋センサを構成する静電容量検出用セルの、たとえば、指等からの放電による静電破壊を抑制可能な静電容量式指紋センサおよびその製造方法を提供する。
【解決手段】指紋との間の距離に応じて変化する静電容量を電気的に検出する複数の静電容量検出用セルを有し、各静電検出用セル３の検出結果に基づいて指紋を認識する静電容量式指紋センサ１であって、指紋に対して基準電位を与える導電性の線材としてのワイヤ１１が静電容量検出用セル３が設けられた検出面２ａを横切って架張されている。



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【特許請求の範囲】

【請求項１】指紋との間の距離に応じて変化する静電容量を電気的に検出する複数の静電容量検出用セルを有し、前記各静電検出用セルの検出結果に基づいて前記指紋を認識する静電容量式指紋センサであって、

前記指紋に対して基準電位を与える導電性の線材が前記複数の静電容量検出用セルが設けられた検出面を横切って架張されている静電容量式指紋センサ。

【請求項２】前記線材は、前記検出面に接触している請求項１に記載の静電容量式指紋センサ。

【請求項３】前記線材は、前記検出面から離隔している請求項１に記載の静電容量式指紋センサ。

【請求項４】前記複数の静電容量検出用セルが形成された半導体チップと、

前記半導体チップを保持する導電性を有する保持部材と、

前記半導体チップの検出面を露出させた状態で前記半導体チップと保持部材とを被覆しかつ固定するパッケージ部材と、を有し、

前記線材の両端部は、前記パッケージ部材によって前記半導体チップに対して固定されている請求項１に記載の静電容量式指紋センサ。

【請求項５】前記パッケージ部材は、樹脂材料からなる請求項３に記載の静電容量式指紋センサ。

【請求項６】前記線材は、前記パッケージ部材内を通って前記保持部材と電気的に接続されている請求項４に記載の静電容量式指紋センサ。

【請求項７】前記パッケージ部材に一部が当該パッケージ部材から突出するように設けられた、基準電位に接続される基準電位用電極を有し、

前記基準電位用電極は、導電性材料によって前記保持部材と接続されている請求項６に記載の静電容量式指紋センサ。

【請求項８】前記半導体チップの検出面側には、前記線材を当該検出面から所定の距離で離隔する位置に保持するためのスペーサ部材が設けられており、

前記線材は、前記スペーサ部材上に前記パッケージ部材によって固定されている請求項４に記載の静電容量式指紋センサ。

【請求項９】前記スペーサ部材は、前記パッケージ部材と同じ材料からなる請求項７に記載の静電容量式指紋センサ。

【請求項１０】前記線材は、カーボンファイバからなる請求項１に記載の静電容量式指紋センサ。

【請求項１１】前記静電容量検出用セルは、検出用電極と、前記検出用電極を被覆する所定膜厚の絶縁性の保護膜とを有する請求項１に記載の静電容量式指紋センサ。

【請求項１２】前記静電容量検出用セルの検出信号を処理して前記指紋を特定する信号処理回路をさらに有し、

前記信号処理回路は、前記線材が横切る、あるいは、前

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記線材が近傍を通過する静電容量検出用セルの検出信号を特定的に処理する請求項１に記載の静電容量式指紋センサ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、指紋を特定するための静電容量式指紋センサおよびその製造方法に関する。

【０００２】

【従来の技術】たとえば、入退室管理等に用いられていた指紋照合システムは、コンピュータネットワーク上のセキュリティシステム、携帯端末、ＩＣカード等の本人認証ツールとしても応用されはじめている。上記の指紋照合システムでは、指紋を認識するための指紋センサとして、静電容量式指紋センサが開発されている。静電容量式指紋センサは、指に基準電位を与えてこの基準電位と指紋センサ内の電極との間に形成される静電容量を電気的に検出する。指紋の凹凸に応じて、基準電位と電極との距離が変化し、静電容量が変化する。この指紋の凹凸に対応した静電容量の変化を電気的に取り出すことにより、指紋の紋様を特定する。

【０００３】

【発明が解決しようとする課題】ここで、図１０は上記の静電容量式指紋センサの構造の一例を示す平面図であり、図１１は上記の静電容量式指紋センサの構造の一例を示す断面図である。図１０に示すように、静電容量式指紋センサ１０１は、マトリクス状に配置された複数の静電容量検出用電極１０２を有しており、各静電容量検出用電極１０２について静電容量検出セルが構成されている。また、静電容量検出用電極１０２上には、図１１に示すように、絶縁性の保護膜１０３が被覆されている。上記構造の静電容量式指紋センサ１０１では、指紋を認識するのに指を基準電位とするため、たとえば、図１２に示すように、静電容量式指紋センサ１０１の検出面１０１ａの近傍に基準電位電極１０５を配設して指Ｆに基準電位を付与している。しかしながら、人体は静電気を帯びやすく、指Ｆに基準電位電極１０５によって基準電位を付与する前に、指Ｆと静電容量式指紋センサ１０１との間で放電が発生することがあり、これによって、静電容量式指紋センサ１０１の静電容量検出セルの保護膜１０３等が絶縁破壊されることがあった。

【０００４】本発明は、上述した問題に鑑みてなされたものであって、静電容量式指紋センサを構成する静電容量検出用セルの、たとえば、指等からの放電による静電破壊を抑制可能な静電容量式指紋センサを提供することを目的とする。

【０００５】

【課題を解決するための手段】本発明は、指紋との間の距離に応じて変化する静電容量を電気的に検出する複数の静電容量検出用セルを有し、前記各静電検出用セルの

検出結果に基づいて前記指紋を認識する静電容量式指紋センサであって、前記指紋に対して基準電位を与える導電性の線材が前記複数の静電容量検出用セルが設けられた検出面を横切って架張されている。

【０００６】前記線材は、前記検出面に接触している。

【０００７】前記線材は、前記検出面から離隔している。

【０００８】前記複数の静電容量検出用セルが形成された半導体チップと、前記半導体チップを保持する導電性を有する保持部材と、前記半導体チップの検出面を露出させた状態で前記半導体チップと保持部材とを被覆しかつ固定するパッケージ部材と、を有し、前記線材の両端部は、前記パッケージ部材によって前記半導体チップに対して固定されている。

【０００９】前記パッケージ部材は、樹脂材料からなる。

【００１０】前記線材は、前記パッケージ部材内を通って前記保持部材と電気的に接続されている。

【００１１】前記パッケージ部材に一部が当該パッケージ部材から突出するように設けられた、基準電位に接続される基準電位用電極を有し、前記基準電位用電極は、導電性材料によって前記保持部材と接続されている。

【００１２】前記チップの検出面側には、前記線材を当該検出面から所定の距離で離隔する位置に保持するためのスペーサ部材が設けられており、前記線材は、前記スペーサ部材上に前記パッケージ部材によって固定されている。

【００１３】前記スペーサ部材は、前記パッケージ部材と同じ材料からなる。

【００１４】前記線材は、カーボンファイバからなる。

【００１５】前記静電容量検出用セルは、検出用電極と、前記検出用電極を被覆する所定膜厚の絶縁性の保護膜とを有する。

【００１６】前記静電容量検出用セルの検出信号を処理して前記指紋を特定する信号処理回路をさらに有し、前記信号処理回路は、前記線材が横切る、あるいは、前記線材が近傍を通過する静電容量検出用セルの検出信号を特定的に処理する。

【００１７】本発明では、指紋を検出する検査面に横切るように指紋に基準電位を与える導電性を有する線材が架張されている。指を検査面に押し当てると、指が線材に確実に接触するため、仮に指からの放電が発生しても、静電気は線材を通じて逃げる。このため、放電によって静電容量検出用セルが破壊されることが抑制される。

【００１８】

【発明の実施の形態】以下、本発明の実施の形態について図面を参照して説明する。

第１実施形態

図１は本発明の静電容量式指紋センサの一実施形態の構造を示す断面図であり、図２は静電容量検出用セルの構造を示す断面図であり、図３は半導体チップの検出面側の構造を示す平面図である。図１～図３に示すように、本実施形態に係る静電容量式指紋センサ１は、半導体チップ２と、ダイパッド４１と、パッケージ部材３１と、ワイヤ１１と、接地電極４５とを有する。

【００１９】半導体チップ２は、図３に示すように、指紋を検出するための複数の静電容量検出用セル３がマトリクス状に形成されている。半導体チップ２は、たとえば、数cm^2程度の面積を有しており、静電容量検出用セル２は、この面積内に、たとえば、数万～数十万個のオーダで形成されており、たとえば、数μm～数十μmの間隔で配置されている。図３に示すように、静電容量検出用セル３は、絶縁層２０上に形成された導電性材料からなる電極２１を有しており、これら電極２１は誘電体からなる保護膜２２で被覆されている。なお、保護膜２２の最表面が上記の検出面２ａとなっている。静電容量検出用セル３の電極２１は、たとえば、アルミニウム等の金属材料から形成されており、一辺の長さが、たとえば、数十μmに形成されている。保護膜２２は、たとえば、ＳｉＮやSiO_2を基材とする厚さ数μmの膜である。

【００２０】静電容量検出用セル３の形成方法は、たとえば、シリコン基板等の半導体基板上に少なくとも絶縁層を介して、たとえば、ＣＶＤ(Chemical Vapour Deposition)法等を用いて金属材料からなる導電層を形成し、通常のフォトリソグラフィ技術を用いてパターニングして電極２１を形成し、電極２１を被覆するように、保護膜２２を所定の膜厚で堆積させる。

【００２１】ダイパッド４１は、半導体チップ２を、たとえば、接着材を介して保持している。ダイパッド４１は、たとえば、銅、アルミニウム等の導電性を有する金属材料からなる板材である。

【００２２】パッケージ部材３１は、半導体チップ２とダイパッド４を被覆するように形成されており、かつ半導体チップ２とダイパッド４とを固定している。また、パッケージ部材３１は、たとえば、通常の半導体装置のパッケージに用いられる樹脂材料から形成されている。また、パッケージ部材３１は、半導体チップ２の検出面２ａが露出するように、開口部３ａを有している。

【００２３】ワイヤ１１は、導電性を有する線材であり、たとえば、ステンレスワイヤ等の線材を用いることができるが、本実施形態では、強度上の観点からカーボンファイバを用いる。ワイヤ１１は、半導体チップ２の検出面２ａに接触した状態で検出面２ａを横切って架張されており、たとえば、図３に示すように、ハッチングで示すような同一方向に配列された静電容量検出用セル３を横断するように設けられる。また、たとえば、図４に示すように、同一方向に配列された各静電容量検出用セル３の間を横断するように設けてもよい。ワイヤ１１

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の両端部は、図１に示したように、半導体チップ２に対してパッケージ部材３１内に一体的に固定されている。

【００２４】ワイヤ１１の一端部１１ａは、ダイパッド４１の表面に接続され、ワイヤ１１とダイパッド４１とは電気的に導通している。

【００２５】接地電極４５は、パッケージ部材３１内に固定され、一部がパッケージ部材３１から突出するように設けられている。接地電極４５は、たとえば、金線、アルミニウムワイヤ等の導電性部材４３によってダイパッド４１と電気的に接続されている。導電性部材４３は、パッケージ部材３１内に存在する。

【００２６】図５は、本実施形態に係る静電容量式指紋センサ１の電気的構成を示す模式図である。図５に示すように、各静電容量検出用セル３の電極２１は、スイッチとして機能するトランジスタ４０を介して信号処理回路５１に接続されている。マトリクス状に配置された静電容量検出用セル３のうち、同じ行に並ぶ静電容量検出用セル３に接続されたトランジスタ４０のゲートは、選択線ＷＬに接続されている。信号処理回路５１は、各静電容量検出用セル３の検出した検出信号に基づいて指Ｆの指紋の像を特定する回路である。

【００２７】ここで、静電容量式指紋センサ１の指紋の検出原理について説明する。図６に示すように、各静電容量検出用セル４の電極２１は、トランジスタ４０を介して列方向の選択線ＢＬに接続され、トランジスタ４０のゲートは行方向の選択線ＷＬに接続されている。基準電位を与えた指Ｆを電極２１から距離ｄの位置に位置させると、電極２１と指Ｆとの間の静電容量Ｃｓは、次式（１）によって表される。なお、ε_0 は空気の誘電率であり、εは電極２１上の保護膜２２の誘電率であり、Ｓは電極２１の面積である。

【００２８】$Cs=\varepsilon\cdot\varepsilon_0\cdot S/d$　　…（１）

【００２９】したがって、静電容量式指紋センサ１の電極２１に指Ｆを対向させない状態では、電極２１と指Ｆとの距離ｄは無限大となり、電極２１上の静電容量Ｃｓは０となる。

【００３０】図７に示すように、指Ｆに基準電位Ｅを与えた状態で、静電容量式指紋センサ１の電極２１に近接させると、指Ｆの有する指紋の凹凸によって、電極２１ａ、２１ｂと指Ｆとの距離ｄは、それぞれｄ１、ｄ２のように異なる。このとき、選択線ＢＬを所定電圧Ｖｃｃでプリチャージし、選択線ＷＬに電圧を印加してトランジスタ４０をオンすると、各電極２１ａ、２１ｂには距離ｄ１、ｄ２によって決定される静電容量Ｃｓに応じた電荷が蓄積され、これら電荷量に応じて選択線ＢＬの電位が変化する。選択線ＢＬの電位変化量ΔＶは、選択線ＢＬの寄生容量をＣｂとすると、次式（２）で表される。

【００３１】

$\Delta V=\{Cs/(Cb+Cs)\}Vcc$　　…（２）

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【００３２】電位変化量ΔＶは、電極２１と指Ｆとの距離ｄによって決定される静電容量Ｃｓに応じた量であり、各静電容量検出用セル２における選択線ＢＬの電位変化量ΔＶを上記した信号処理回路５１に読みだすことで、指Ｆの有する指紋の凹凸状態を特定することができる。

【００３３】次に、上記構成の静電容量式指紋センサ１の指紋検出動作の一例について説明する。たとえば、静電容量式指紋センサ１に接触させる指Ｆが帯電しており、指Ｆに基準電位Ｅを与える前に指Ｆから静電容量式指紋センサ１に向けて放電する場合を考える。なお、静電容量式指紋センサ１の接地電極４５は接地されているものとする。図８に示すように、指Ｆを半導体チップ２の検出面２ａに接触させると、検出面２ａ上にはワイヤ１１が横断しているので、指Ｆはワイヤ１１に確実に接触すする。これによって、指Ｆには基準電位である接地電位が付与される。指Ｆを半導体チップ２の検出面２ａに近づけた際に、人体が帯電しており指Ｆから放電すると、放電電流はワイヤ１１に流れ、ダイパッド４１および導電性部材４３を通じて接地された接地電極４５に導かれる。このため、放電電流が静電容量検出用セル３に直接流れることがなく、放電によって、たとえば、静電容量検出用セル３の有する保護膜２２等が絶縁破壊することが抑制される。以上のように、本実施形態によれば、複数の静電容量検出用セル３が形成された検出面２ａ上に導電性を有するワイヤ１１を設けたことで、静電容量検出用セル３は指Ｆから放電が生じても破壊されにくくなる。

【００３４】ここで、図８に示したように、半導体チップ２の検出面２ａに指Ｆを接触させた状態では、指Ｆがワイヤ１１に接触するため、この接触領域では指Ｆは変形する。このため、指Ｆが変形した領域では、指紋を検出することができない不感領域Ｒが発生する。たとえば、図３に示したように、ワイヤ１１を同一方向に配列する静電容量検出用セル３を横断するように設けた場合には、図３においてハッチングで示す一列に並ぶ各静電容量検出用セル３が不感領域Ｒ内に位置することになる。また、図４に示したように、ワイヤ１１を同一方向に配列する静電容量検出用セル３の間に設けた場合には、図４においてハッチングで示す隣り合う２列の各静電容量検出用セル３が不感領域Ｒに位置することになる。

【００３５】不感領域Ｒに位置する静電容量検出用セル３は、静電容量式指紋センサ１の組み立て段階においてワイヤ１１の配置に応じて予め特定されている。このため、本実施形態では、たとえば、信号処理回路５１で不感領域Ｒに位置する静電容量検出用セル３の検出信号を特定的に処理する。具体的には、たとえば、信号処理回路５１は、不感領域Ｒに位置する静電容量検出用セル３の検出信号を指紋の特定に使用しない構成とすることが

できる。この場合には、指Ｆを半導体チップ２の検出面２ａに対して異なる位置に複数回接触させ、複数回の検出で得られたデータを合成することにより、指紋の全体像を特定することができる。あるいは、不感領域Ｒに位置する静電容量検出用セル３の検出信号を特別に処理するアルゴリズムを予め用意しておき、このアルゴリズムによって不感領域Ｒに位置する静電容量検出用セル３の検出信号を補完することで、指紋の全体像を特定することも可能である。

【００３６】第２実施形態

図９は、本発明の静電容量式指紋センサの一実施形態の構造を示す断面図である。なお、図９に示す静電容量式指紋センサ２０１の構成要素のうち、上述した第１の実施形態と同一の構成要素については同一の符号で示している。本実施形態に係る静電容量式指紋センサ２０１と第１の実施形態に係る静電容量式指紋センサ１との異なる点は、静電容量式指紋センサ２０１では、ワイヤ１１が半導体チップ２の検出面２ａと所定の距離δで離隔している点である。

【００３７】すなわち、静電容量式指紋センサ２０１では、半導体チップ２上に高さδの複数のスペーサ部材４６が設けられており、ワイヤ１１はスペーサ部材４６上に架張され、パッケージ部材３１と一体に固定されている。スペーサ部材４６は、たとえば、パッケージ部材３１と同一の樹脂材料によって形成することができる。

【００３８】本実施形態では、このような構成とすることにより、半導体チップ２の検出面２ａに指Ｆを近づけていくと、半導体チップ２の検出面２ａよりもワイヤ１１のほうが指Ｆにより近いため、指Ｆから放電しても放電電流が確実にワイヤ１１に導かれ、半導体チップ２に形成された静電容量検出用セルの静電破壊を確実に防ぐことができる。

【００３９】

【発明の効果】本発明によれば、静電容量式指紋センサの検出面を横切るように基準電位を与えるワイヤを設けたことにより、指からの放電があっても静電容量検出用セルの静電破壊を確実に防止することができ、かつ、指に基準電位を与えることができる。

【図面の簡単な説明】

【図１】本発明に係る静電容量式指紋センサの一実施形態の構成を示す断面図である。

【図２】静電容量検出用セルの構造を示す断面図である。

【図３】半導体チップの検出面側の構造を示す平面図である。

【図４】半導体チップの検出面側の他の構造例を示す平面図である。

【図５】静電容量式指紋センサ１の電気的構成を示す模式図である。

【図６】静電容量式指紋センサの構造の一例を示す平面図である。

【図７】静電容量式指紋センサの検出原理を説明するための図である。

【図８】静電容量式指紋センサ１の半導体チップ２の検出面２ａに指Ｆを近接させた状態を示す図である。静電容量式指紋センサの構造の一例を示す断面図である。

【図９】本発明に係る静電容量式指紋センサの他の実施形態の構成を示す断面図である。

【図１０】静電容量式指紋センサの構造の一例を示す平面図である。

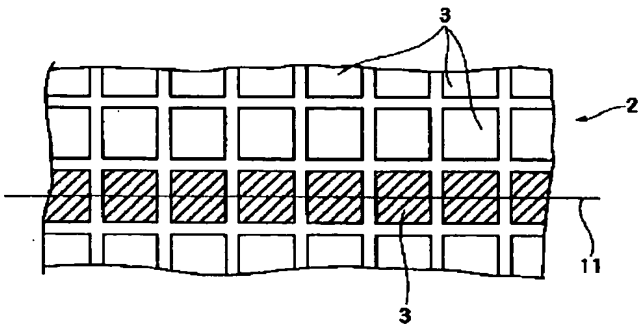
【図１１】図１０の静電容量式指紋センサの構造の一例を示す断面図である。

【図１２】静電容量式指紋センサに指を接触させる際に、指に基準電位を与える様子を示す図である。

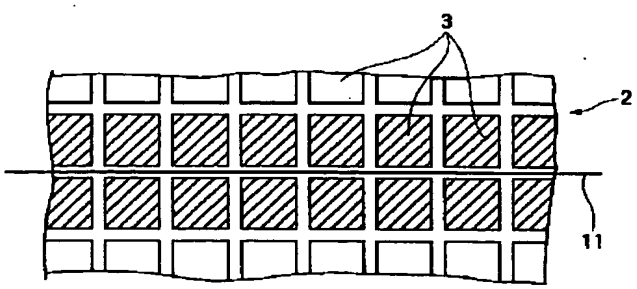
【符号の説明】

１…静電容量式指紋センサ、２…半導体チップ、２ａ…検出面、３…静電容量検出用セル、１１…ワイヤ、３１…パッケージ部材、４３…導電性部材、４５…接地電極、２１…電極、２２…保護膜、４１…ダイパッド。

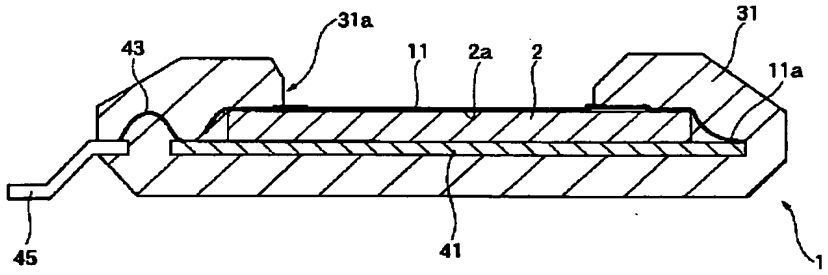
【図３】



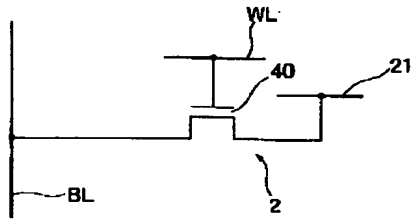
【図４】



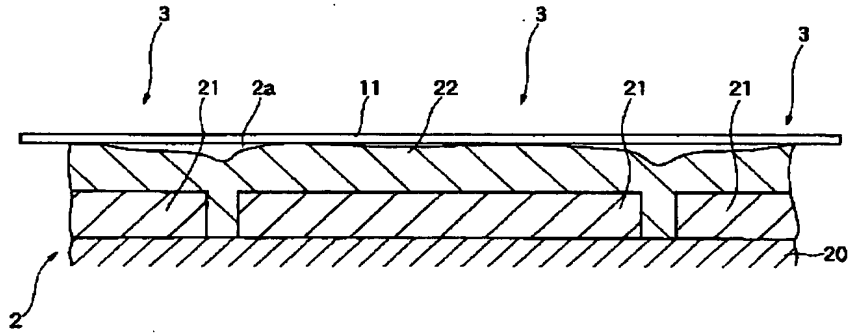
【図１】


31a
43
11
2a
2
31
11a
45
41
1

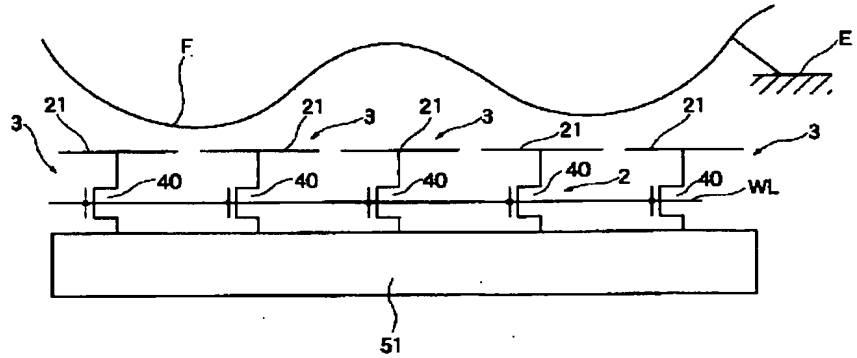
【図６】


WL
40
21
BL
2

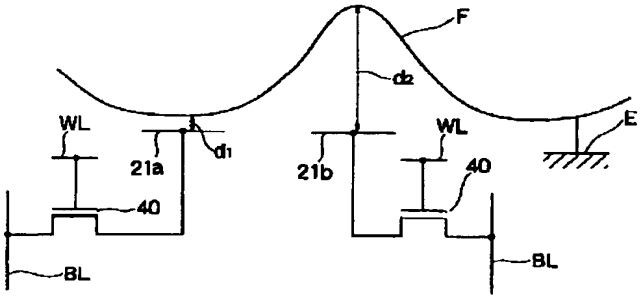
【図２】


3
3
3
21
2a
11
22
21
21
20
2

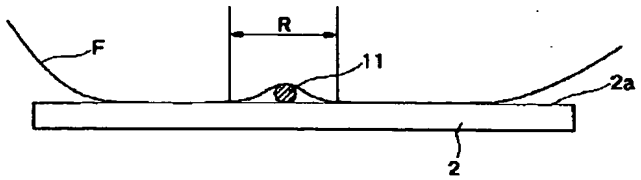
【図５】


F
E
21
21
3
21
3
21
21
3
3
40
40
40
40
2
40
WL
51

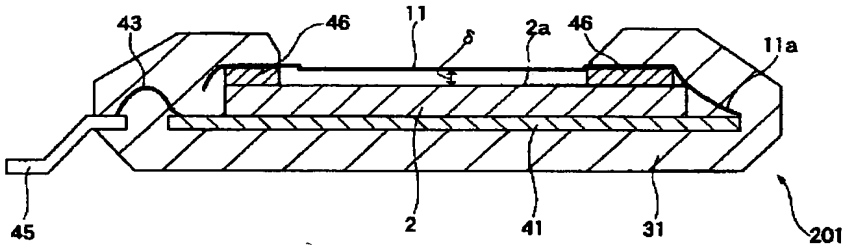
【図７】



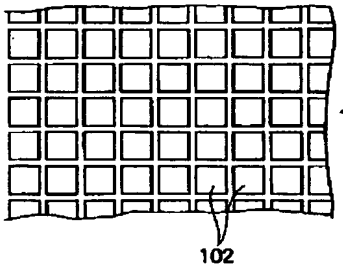
【図８】



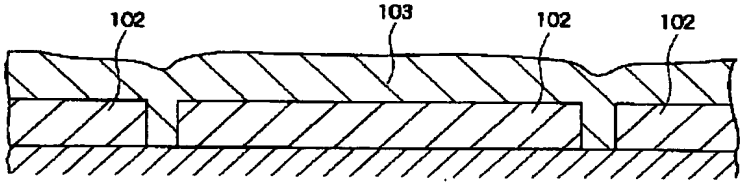
【図９】



【図１０】



【図１１】



【図１２】